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Comparison of sarcopenic status between elderly leprosy survivors and general population

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ABSTRACT

Because of chronicity and poor environments, elderly leprosy survivors might be at greater risk of developing obesity and sarcopenia than healthy individuals. This study aimed to investigate whether body composition and the prevalence of obesity and sarcopenia among elderly leprosy survivors with no or mild physical impairment differ from those of the general population. A total of 36 leprosy survivors aged 65–90 years with no or mild physical impairment were recruited. Individuals matched for sex, age, and height were selected as a control group from the Fourth Korea National Health and Nutrition Examination Survey. Anthropometric characteristics, body composition, appendicular skeletal muscle mass (ASM), modified skeletal muscle mass index (SMI), and the prevalence of obesity and sarcopenia were compared between the leprosy survivors and the control group. Compared to the control group, the leprosy survivors had higher body weight, BMI, total fat mass, and total fat percentage. The leprosy survivor group also had lower ASM ($P = 0.035$) and SMI ($P < 0.001$) values. Comparison of the composition of regional body parts showed that the lean body mass of the legs was lower in the leprosy survivor group even though this group had higher body weight. The leprosy survivor group also had a significantly higher prevalence of sarcopenia than the control group (38.7% vs. 5.6%; $P = 0.002$). These findings suggest that leprosy survivors are at greater risk of developing obesity and sarcopenia than healthy individuals. Further researches are required to investigate causes and mechanisms of sarcopenia in leprosy survivors.

1. Introduction

Obesity causes chronic conditions, including cardiovascular diseases and type 2 diabetes mellitus, and increases overall mortality (Ford, 2004; Haslam & James, 2005; Lakka et al., 2002). It also causes osteoarthritis of the lower extremities and mobility disorders (Tukker, Visscher, & Picavet, 2009). Sarcopenia also has a strong impact on functional status, falls, and mortality in the elderly (Baumgartner et al., 1998; Malafarina, Uriz-Otano, Iniesta, & Gil-Guerrero, 2012; Melton et al., 2000; Visser & Schaap, 2011). It is also related to a reduction in bone mineral density (BMD), which could increase the risk of fracture (Cui et al., 2007; Ho-Pham, Nguyen, Lai, & Nguyen, 2010; Kim et al., 2009; Lekamwasam, Weerarathna, Rodrigo, Arachchi, & Munidasa, 2009). Because increased fat mass and decreased muscle mass are the predominant body composition changes that occur among the elderly (Mathus-Vliegen and Obesity Management Task Force of the European Association for the Study of, 2012; Raguso et al., 2006), these individuals are at risk of developing obesity and sarcopenia. Furthermore, research suggests that simultaneous occurrence of excess body fat and sarcopenia exacerbates the risk of developing multiple health-related problems (Baumgartner et al., 2004; Davison, Ford, Cogswell, & Dietz, 2002; Stenholm et al., 2008). Therefore, preventing these 2 conditions is crucial for maintaining the health, physical function, and quality of life of the elderly.

As the awareness of sarcopenia has been raised, there have been substantial amount of researches on sarcopenia in general populations (Baumgartner et al., 1998; Hwang et al., 2012; Lin et al., 2013) and patients with specific diseases (Hayashi et al., 2013; Kato et al., 2011; Villasenor et al., 2012). It is of note that a

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specific disease has its own mechanisms to cause or accelerate sarcopenia (Hayashi et al., 2013; Kato et al., 2011; McDonald, Abresch-Meyer, Nelson, & Widman, 2007), which should be considered when planning management or prevention. Some disease conditions such as stroke and spinal cord injuries are direct causes of muscle atrophy and severe impairments. Increased fat mass and decreased muscle mass are obvious effects of these conditions (McDonald et al., 2007). On the other hand, disease conditions without evident physical impairment also increase the risk of developing obesity and sarcopenia through variety of mechanisms. People with stigmatized diseases such as leprosy, HIV infection, and mental illness commonly suffers from their chronicity (Colvin, 2011; Holzemer, 2002), polypharmacy (Bain-Brickley, Butler, Kennedy, & Rutherford, 2011; Weiand, Thoulass, & Smith, 2012), nutritional problems (Gibson, Carek, & Sullivan, 2011; Onyango, Walingo, Mbagaya, & Kakai, 2012), low socioeconomic status (Raju & Rao, 2011), and limitations in physical activity (Rocha, de Araujo, de Almeida, & Virtuoso, 2012; Slim, van Schie, Keukenkamp, Faber, & Nollet, 2010), all of which can contribute to obesity and sarcopenia. However, few studies have analyzed the body composition characteristics and the prevalence of obesity and sarcopenia in patients with those diseases. Leprosy, as a typical stigmatized disease, is one of the oldest diseases, causing permanent damage to the skin, nerves, and limbs (Moonot, Ashwood, & Lockwood, 2005). Physical impairments, such as joint contractures or amputations, give rise to disabilities, which restricts physical activities and social participations (van Brakel et al., 2012). Since the development of dapsone and multidrug therapy, many patients have been cured with no or only mild sequelae. Yet, leprosy is still common in developing countries, including India and Brazil (Suzuki et al., 2012) and more than 200 000 people with leprosy are newly detected every year globally (World Health Organization, 2012).

Considering factors involved in the disease course of leprosy, its treatment, and socioeconomic environments, leprosy survivors might be at greater risk of developing obesity and sarcopenia than healthy individuals, even in survivors with no or mild impairment. However, no study has investigated body composition characteristics and the prevalence of obesity and sarcopenia among leprosy survivors. This study, therefore, aimed to investigate whether body composition and the prevalence of obesity and sarcopenia differ between leprosy survivors with no or mild physical impairment and the general population.

2. Materials and methods

2.1. Subjects

A cross-sectional study was conducted in a local leprosy center located in Yeosu-si, Jeollanam-do, Korea. Two leprosy villages with 147 leprosy survivors (65 men and 82 women) were affiliated with this center. Among them, 117 (55 men and 62 women) were aged 65 years or older. Most leprosy survivors in the villages visit the center regularly, although they were cured from leprosy. Recruitment information with inclusion and exclusion criteria was announced to leprosy survivors in outpatient clinic of the center. Volunteered survivors who were fit to the criteria were included. The inclusion criteria was subjects who were aged 65 years or more, community ambulators, and who had been cured from leprosy. Subjects were excluded if they were not community ambulators, if they had any structural or systemic disorders that could severely affect their mobility or body composition analysis results such as amputation above the level of the wrist or ankle or a history of arthroplasty, stroke, or spinal cord injury. Finally, 36 leprosy survivors (14 men, 22 women) were included in the leprosy survivor group. Their mean age was 74.4 ± 6.9 years, and the mean age at leprosy onset was 17.3 ± 5.2 years. According to the World Health Organization leprosy disability grading system (WHO-DG) (Pannikar, 2009), there were 18 subjects with DG (disability grade) 0 (no disability), 8 with DG 1 (loss of sensation), and 8 with DG 2 (visible damage or disability). 8 subjects with DG2 had mild deformities of the upper and lower extremities. In the feet, 2 with DG 2 had toe amputations. In the hands, 6 with DG 2 had undergone finger amputations or hand contractures. There were no other proximal joint involvement above the wrists or ankles.

The subjects in the control group were selected from among the participants of the Fourth Korea National Health and Nutrition Examination Survey (KNHANES IV-3), 2009, which was conducted by the Korea Centers for Disease Control and Prevention. This was a large, nationwide representative survey that included 10 533 people. Of these, 1578 individuals aged ≥65 years completed anthropometric measures and had their body composition data analyzed by dual energy X-ray absorptiometry (DXA). The control group individuals were selected from among these 1578 individuals by propensity score matching with the leprosy survivor group. A logistic-regression model was created to derive a propensity score with age and height in each sex-matched group. After this process, 36 subjects who were matched by sex, age, and height to 36 leprosy survivors were included in the control group. This matching process was supported by the Medical Research Collaborating Center of our hospital.

2.2. Measurements

Height and body weight were measured using standard methods. Body mass index (BMI) was calculated as the weight divided by the height squared (kg/m^2). Obesity was defined as a BMI over 25 kg/m^2.

Waist circumference (WC) was measured to evaluate the status of abdominal obesity. WC ≥90 cm in men and ≥85 cm in women were defined as abdominal obesity (Lee et al., 2007). It was measured at the midpoint between the lower margin of the last palpable rib and the top of the iliac crest at the end of a normal expiration with the arms relaxed at the sides. This method was also used in KNHANES IV-3. Body composition and whole body BMD were measured by DXA using the same instrument (DISCOVERY-W fan-beam densitometer; Hologic, Inc., Bedford, MA, USA), and standard procedures as were used in KNHANES IV-3. Fat mass, lean mass, and BMD were measured. Lean mass was defined as soft tissue mass excluding fat mass, and it indicates muscle mass in the case of limbs. Body fat percentage was defined as the percentage of fat mass in the whole body weight.

To determine the difference of body composition in different body parts, fat mass, lean mass, and fat percentage were also measured in regional body parts such as the arms, legs, and trunk. Appendicular skeletal muscle mass (ASM) was calculated as the sum of lean mass in both arms and both legs. So it indicates the sum of muscle mass in the four extremities.

The status of sarcopenia was characterized using the modified skeletal muscle mass index (SMI), which was modified from the original definition of Janssen, Heymsfield, and Ross (2002). It was defined as ASM divided by body weight (ASM/body weight), and presented as percentage (%). It is known to reflect metabolic impairment better than other indices (Kim et al., 2010; Lim et al., 2010). Sarcopenia was defined as an SMI value more than 2 standard deviations (SD) less than the mean value for sex-specific young, healthy individuals (age, 20–39 years). In Koreans, the cutoff points are 29.53% in men and 23.20% in women (Hwang et al., 2012). Therefore sarcopenia was diagnosed in this study when SMI were below these sex-specific cutoff points. The definition of sarcopenic obesity combines the definitions of sarcopenia according to SMI and obesity according to BMI.